Fisheries and Oceans
Canada

Ecosystems and
Oceans Science

Pêches et Océans
Canada

Sciences des écosystèmes
et des océans

Maritimes Region

**Canadian Science Advisory Secretariat
Science Response 2016/023**

UPDATED INFORMATION ON FISHING BYCATCH OF THE ATLANTIC SALMON, INNER BAY OF FUNDY POPULATION, AND ITS IMPACT ON THE SURVIVAL OR RECOVERY OF THIS ATLANTIC SALMON DESIGNATABLE UNIT (DU)

Context

The Committee on Endangered Wildlife in Canada (COSEWIC) identified the inner Bay of Fundy (iBoF) Atlantic Salmon assemblage as a Designatable Unit (DU). The DU includes all drainages from the Mispec River, NB to the Pereaux River, NS (DFO 2010). Atlantic Salmon iBoF population, was included as 'Endangered' on Schedule 1 of the *Species at Risk Act* (SARA) when the *Act* was passed in 2003. Following the coming into force of SARA, an Allowable Harm Assessment (Amiro 2004) and Recovery Potential Assessment (RPA) (DFO 2008; Gibson et al. 2008) were completed to evaluate the scope for harm to this species under existing conditions. As required by SARA, a Recovery Strategy was completed for iBoF Salmon (DFO 2010). Supported by the scope for harm, as outlined in the RPA, the Recovery Strategy includes a list of existing licensed activities that are permitted to continue under SARA via the Recovery Strategy. Exempting activities in this manner must not compromise the goals and objectives of the Recovery Strategy. In other words, such activities must not jeopardize the survival or recovery of the population.

Updated iBoF Salmon bycatch information and advice on its impact on the survival or recovery of this population assemblage was requested by the Species at Risk Management Division (SARMD), Fisheries and Oceans Canada (DFO), Maritimes Region, for consideration in upcoming amendments to the Recovery Strategy. The objectives of this request were to:

- provide any new information regarding iBoF salmon bycatch in existing licensed commercial, recreational, and Aboriginal fisheries in inland and tidal waters of the Bay of Fundy,
- describe the impact of these activities on the survival or recovery of iBoF Salmon that was not considered in previously-published DFO Science advice (Amiro 2004, DFO 2008), and
- verify accuracy of conclusions drawn in previously-published DFO Science advice (Amiro 2004, DFO 2008) regarding the potential impact of these activities on the survival or recovery of iBoF Salmon if new information does exist, and provide updated conclusions and advice, if required.

Given that this request was for an update of previous advice using established methods (Amiro 2004; DFO 2008; DFO 2010; Clarke et al. 2014), it was decided to use the Science Response Process. This information will be used to inform DFO management decisions.

Overall, salmon bycatch data continues to be unavailable for the iBoF DU rendering the current level of fishing bycatch unquantifiable. Although at-sea survival remains very low, the level of uncertainty around bycatch fishing mortality continues to warrant precautionary management measures.

May 2016

This Science Response Report results from the Science Response Process of September 10, 2015, on the Updated Information on Fishing Bycatch of Atlantic salmon, Inner Bay of Fundy Population, and its Impact on the Survival or Recovery of this Atlantic Salmon Designatable Unit (DU).

Background

Population Status

Although COSEWIC reconfirmed the iBoF Salmon's *Endangered* designation in 2010 (COSEWIC 2010), a full assessment of the status of the iBoF Salmon population has not been conducted since 2008 (Gibson et al. 2008; DFO 2008). Therefore, the population status of the iBoF Salmon, as well as at-sea mortality rates, was updated for inclusion in this review to evaluate the possible effects of bycatch on the current iBoF Salmon population's recovery potential.

Gibson et al. (2008) assessed at-sea-survival to evaluate the iBoF Salmon's capacity to recover under varying conditions, including increasing levels of human impact (e.g., bycatch levels). In order to update the possible effect of bycatch on the current population level, at-sea-survival was re-assessed based on data from the Big Salmon River.

The iBoF Salmon Recovery Strategy identifies 10 rivers that contained residual native populations essential to the persistence of iBoF Salmon: Big Salmon, Upper Salmon, Point Wolfe, Economy, Portapique, Great Village, Folly, Debert, Stewiacke, and Gaspereau rivers. Of these 10 critical rivers, only the Portapique does not receive support from the Live Gene Bank (LGB) program (i.e., a captive rearing program designed to minimize the loss of genetic diversity, such that the populations can be restored when conditions become favorable for their survival in the wild [O'Reilly and Harvie 2010]).

Population status is evaluated using a comparison of the estimated egg deposition (calculated from the estimated abundance and biological characteristics) relative to a reference point known as the conservation requirement (i.e., 2.4 eggs/m^2). Additional indicators of population status include juvenile salmon densities and smolt abundance estimates. A summary of assessment data available for each salmon life stage for 50 rivers in the iBoF region is provided in Table 1. Of these, the Big Salmon River in NB and the Gaspereau River in NS are the rivers with ongoing programs to monitor the status of the iBoF Salmon in the wild.

A summary of the population status on these rivers within the last five years, and a summary of the results of a broadscale electrofishing survey conducted in 2014, are provided below.

Big Salmon River

Adult returns: Counts of small and large salmon from snorkel surveys are used to estimate the total number of returning adult salmon to the Big Salmon River each year. When numbers allow, mark and recapture techniques are used to estimate the snorkel observation rates. Estimates of total adult returns from 2010 to 2014 have averaged 56 fish with a range of 11 (2014) to 118 (2011) (Table 1). Returns to the Big Salmon River in each of the past five years has remained below the conservation requirement (2.2 million eggs) and has contributed to less than 12 % of the requirement in each year from 2010 to 2014.

Smolt abundance and return rates: A Rotary Screw Trap (RST, also known as smolt wheel) has been operated on the Big Salmon River just above the high tide marker since 2001. Using mark and recapture methods, smolt assessments have been conducted from 2001 to 2015. The RST is also used to collect smolts for the LGB broodstock program. The mean annual smolt production for the previous five years (excluding 2015, as assessment still underway) is 12,690. The return rate from smolt to one-sea-winter (1SW) salmon is an indicator of survival at-sea and the previous five-year mean is 0.27% (ranging from 0.04-0.61%) (Table 1). The return rate for the Big Salmon River indicates that there has been no significant improvement in marine survival for the iBoF populations since the RPA was completed (DFO 2008).

Gaspereau River

Adult returns: Adult salmon returns to the Gaspereau River are monitored by counting the number of small and large salmon ascending the fish ladder that provides upstream passage above the dam at the White Rock Hydroelectric Facility. In the past five seasons (2010-2014), adult salmon counts have averaged six fish and have ranged from two to 13. Based on results of genetic analysis, the majority (62%) of the returns have been of LGB origin. From 2010-14, the Gaspereau River Salmon population destined for rearing habitat upriver of the White Rock Hydroelectric Facility has remained below the conservation requirement (520,000 eggs) with estimated egg depositions below 9% of the requirement in each of these five years.

Smolt abundance and return rates: Smolt assessment facilities in three downstream surface bypasses at the White Rock Hydroelectric Facility are operated to assess smolt abundance and to collect smolts for the LGB program. The mean number of smolts captured in the bypasses from 2011 to 2015 has averaged 1,060 and counts have ranged between 212 (2014) to 2,441 (2011) smolts. The efficiencies of the bypasses vary annually and smolt abundance estimates are not available annually, therefore no smolt-to-adult return rates have been calculated for this river.

Broadscale Electrofishing Survey

In 2014, an extensive electrofishing survey was undertaken to look for the presence of juvenile salmon in primarily 'non-LGB' supported rivers (i.e., no salmon, at any stage, had been stocked in the rivers for at least four years prior to the survey). Exceptions were: the Great Village River, which received juveniles in 2010, and Salmon River (Truro), which had been stocked annually with adults as a way to evaluate spawning success of an adult stocking strategy. During the 2014 broadscale survey, a total of 33 rivers were surveyed and this resulted in juvenile salmon captured in only 7 rivers (range: one to 31 salmon caught per river, one to six sites fished per river). Only 5 non-LGB supported rivers had juvenile salmon present: 4 New Brunswick rivers (Irish, Mosher, Black, and Mispec rivers) and the Portapique River in Nova Scotia. These 4 New Brunswick rivers are not included in the iBoF Salmon's long term recovery targets (DFO 2010) and although juveniles were found in these 4 rivers, they were at low densities. The Portapique River has been identified as a river containing critical habitat and, therefore, essential to the survival or recovery of iBoF Salmon (DFO 2010). The genetic origin of the juveniles caught in all rivers during the broadscale survey has yet to be determined. Juvenile origin is an important unknown warranting further study, as the majority of the rivers (aside from the Portapique) with juveniles present were in close proximity to the outer Bay of Fundy (oBoF) DU, and juvenile production could be the result of straying adults salmon spawning in these rivers (DFO 2008).

Table 1- A summary of the recent (2010-2014) assessment data available for each salmon life stage in the 50 iBoF rivers (refer to Appendix 3 for a map showing location of these rivers). The rivers are grouped based on LGB status and the categories outlined in the Recovery Strategy (DFO 2010) as well as identified geographically by a combination of the pertinent Important Habitat Area (DFO 2013) and BoF location code as well as the Fisheries Statistical District (FSD) of interest. These designations are used in the qualitative assessment analysis in Table 2. The mean with range in () is presented when available. Rivers not assessed for specific life stage identified by ".".

River	Prov.	River Map No.	River Category[1]	Imp. Hab. Area[2]	FSD[3]	Assessment Data (2010-14)			LGB Releases (2010-14)				Smolt-to-1SW Return Rate
						Adults	Smolts	Juveniles[4]	Fry	Parr	Smolt	Adult	
Gaspereau	NS	4	LGB5 TOP10 TOP19 iBoF32	2MB	41	6 (2-13)	Present	.	X	X	X	X	.
Stewiacke	NS	10	LGB5 TOP10 TOP19 iBoF32	2MB	42	Present	Present	.	X	X	X	X	.
Upper Salmon	NS	37	LGB5 TOP10 TOP19 iBoF32	2CB	79	Present	Present	.	X	X	.	X	.
Point Wolfe	NB	38	LGB5 TOP10 TOP19 iBoF32	2CB	79	Present	Present	.	.	X	.	X	.
Big Salmon	NB	43	LGB5 TOP10 TOP19 iBoF32	3BoF	48	56 (11-118)	12,690	.	X	X	X	X	0.27% (.04-.61%)
Debert	NS	14	TOP10 TOP19 iBoF32	2MB	43	.	.	.	X	X	.	X	.
Folly	NS	15	TOP10 TOP19 iBoF32	2MB	43	.	.	.	X	X	.	X	.
Great Village	NS	16	TOP10 TOP19 iBoF32	2MB	43	.	.	Present	X	X	.	X	.
Portapique	NS	17	TOP10 TOP19 iBoF32	2MB	43	.	.	Present	.	.	.	.	.
Economy	NS	19	TOP10 TOP19 iBoF32	2MB	43	.	.	.	.	X	X	X	.
Shubenacadie	NS	9	TOP19 iBoF32	2MB	42	.	.	Absent	.	.	.	.	.

River	Prov.	River Map No.	River Category[1]	Imp. Hab. Area[2]	FSD[3]	Assessment Data (2010-14)			LGB Releases (2010-14)				Smolt-to-1SW Return Rate
						Adults	Smolts	Juveniles[4]	Fry	Parr	Smolt	Adult	
Salmon (Truro)	NS	11	TOP19 iBoF32	2MB	43	.	.	Present	X	.	X	X	.
North (Truro)	NS	12	TOP19 iBoF32	2MB	43	.	.	Absent	.	.	.	.	.
Chiganois	NS	13	TOP19 iBoF32	2MB	43	.	.	Absent	X	.	.	.	.
Bass	NS	18	TOP19 iBoF32	2MB	44	.	.	Absent	.	.	.	.	.
Harrington	NS	21	TOP19 iBoF32	2MB	43/44	.	.	Absent	.	.	.	.	.
Apple	NS	26	TOP19 iBoF32	2CB	24	.	.	Absent	.	.	.	.	.
Maccan	NS	28	TOP19 iBoF32	2CB	24	.	.	Absent	.	.	.	.	.
Petitcodiac	NB	32	TOP19 iBoF32	2CB	81	Present	Present	.	X	.	.	X	.
Cornwallis	NS	3	iBoF32	2MB	41	.	.	.	X	X	X	X	.
St. Croix	NS	7	iBoF32	2MB	42	.	.	Absent	.	.	.	X	.
Kennetcook	NS	8	iBoF32	2MB	42	.	.	Absent	.	.	.	.	.
Parrsboro	NS	23	iBoF32	2MB	44	.	.	Absent	.	.	.	.	.
Dilligent	NS	24	iBoF32	2MB	44	.	.	Absent	.	.	.	.	.
River Hebert	NS	27	iBoF32	2CB	24	.	.	Absent	.	.	.	.	.
Tantramar	NB	29	iBoF32	2CB	81	.	.	.	.	.	.	.	.
Demoiselle	NB	34	iBoF32	2CB	79	.	.	Absent	.	.	.	.	.
Crooked Creek	NB	35	iBoF32	2CB	79	.	.	Absent	.	.	.	.	.
Shepody	NB	36	iBoF32	2CB	79	.	.	Absent	.	.	.	.	.
Irish	NB	44	iBoF32	3BoF	48	.	.	Present	.	.	.	.	.
Mosher	NB	45	iBoF32	3BoF	48	.	.	Present	.	.	.	.	.
Black	NB	49	iBoF32	3BoF	48	.	.	Present	.	.	.	.	.
Memramcook	NB	31	.	2CB	81	.	.	Absent	.	.	.	.	.
Weldon	NB	33	.	2CB	79	.	.	.	.	.	.	.	.
Goose	NB	39	.	2CB	79	.	.	.	.	.	.	.	.
Quiddy	NB	41	.	2CB	79	.	.	Absent	.	.	.	.	.
Little Salmon	NB	42	.	3BoF	48	.	.	Absent	.	.	.	.	.
Bains Bk.	NB	46	.	3BoF	48	.	.	.	.	.	.	.	.
Gardner Creek	NB	47	.	3BoF	48	.	.	Absent	.	.	.	.	.
Emerson	NB	48	.	3BoF	48	.	.	Absent	.	.	.	.	.

River	Prov.	River Map No.	River Category[1]	Imp. Hab. Area[2]	FSD[3]	Assessment Data (2015-16)			LGB Releases (2015-16)				Smolt-to-1SW Return Rate
						Adults	Smolts	Juveniles[4]	Fry	Parr	Smolt	Adult	
Mispec	NB	50		3BoF	48			Present					
Pereaux	NS	1		2MB	41								
Habitant	NS	2		2MB	41								
Halfway	NS	5		2MB	42			Absent					
Avon	NS	6		2MB	42			Absent					
North	NS	20		2MB	43			Absent					
Moose	NS	22		2MB	44			Absent					
Ramshead	NS	25		2MB	44			Absent					
Carters	NB	30		2CB	81			Absent					
Goose Creek	NB	40		2CB	79								

[1] LGBR-rivers with LGB program. TOP10-rivers containing critical habitat. TOP10- rivers identified in the long-term recovery target. iBoF 32-rivers identified as having historically supported self-sustaining populations (DFO 2008). Several other rivers receive support (i.e., salmon releases) from the LGB program however the LGBR are the primary genetic contributors to those efforts.

[2] 2CB-rivers flow into Chignecto Bay and 2MB-rivers flow into Minas Basin of Important Habitat Area 2. 3BoF- rivers flow into Important Habitat Area 3 (Appendix 1a).

[3] Certain fishing licenses are assigned to a Fishing Statistical Districts. These are used to subdivide the existing provincial counties into smaller units, based on some geographic landmark mainly for reporting purposes (A. Gillis, pers. comm.).

[4] Based on broadscale electrofishing survey of iBoF rivers in 2014 (unpublished data).

Spatial and Temporal Distribution

The freshwater spatial distribution of remaining iBoF Salmon populations includes the 10 rivers receiving LGB support within the past five years (2015-2019) and the five non-LGB supported rivers with juvenile salmon present during the 2019 electrofishing survey (Table 1). In 2013, DFO reviewed and evaluated the available iBoF Salmon data to identify important marine and estuarine habitat needed to complete all life-history stages (DFO 2013). Based on several criteria, including the number of life stages using the area and the area's importance to the life-history stage, the DFO (2013) identified the inner portions of 10 iBoF Salmon rivers (Area 1), Minas Basin and Chignecto Bay (Area 2), and coastal Southwest Nova Scotia: Port George to Hall's Harbour (Area 6), as the highest priority areas. The Bay of Fundy New Brunswick coastal outflow (Area 3), Passamaquoddy Bay/Fundy Isles (Area 4), the middle of the Bay of Fundy (Area 5), and coastal Southwest Nova Scotia: Yarmouth to Port George (Area 7), were identified as the next highest priority areas. The Canadian portion of the Gulf of Maine (Grand Manan southward to latitude [illegible]) (Area 8) was considered to be data deficient (Appendix 1a). The entire Bay of Fundy outward to the northern Gulf of Maine, including estuaries of iBoF salmon rivers, are important habitat between May and October (at a minimum) (DFO 2013). The data available to determine habitat important for overwintering for all stages (November to April period) is limited, but overwintering is suggested to be off the Scotian Shelf or in the southern portion of the Gulf of Maine (Marshall 2014; Lacroix 2013).

Analysis and Response

New Information Regarding iBoF Atlantic Salmon in Existing Licensed Fisheries

Sources queried to evaluate the level of bycatch in commercial, recreational, and Aboriginal fisheries included: the DFO Maritimes Fisheries Information System (MARFIS) catch and effort database, which includes data from dockside monitoring programs; the Industry Surveys Database (ISDB), which houses the at-sea observer data; personal communications with DFO biologists responsible for pertinent species assessments; the Departmental Violation Records (DVR) for any salmon bycatch infraction reported by conservation officers in the iBoF area; Aboriginal Food, Social, and Ceremonial fisheries records; detailed recreational catch records for both Nova Scotia (NS) and New Brunswick (NB); the NB provincial Enforcement Patrol Creel survey records; as well as personal communications with resource managers responsible for each fishery of interest.

Given the limited number of salmon bycatch records, the licensed amount of freshwater, tidal and marine fisheries gear within the iBoF is also summarized. This review was mostly restricted to the Minas Basin, Chignecto Bay, and Kings County (NS) area to better infer that the salmon under threat of being caught are of iBoF origin rather than salmon from other DUs that migrate within the Bay of Fundy (e.g., outer Bay of Fundy [oBoF] and Southern Upland [SU] DUs). In contrast, the review for possible salmon bycatch incidences in the fisheries data captured in MARFIS and the ISDB included the whole Bay of Fundy but results would need to be scrutinized as the origin of salmon cannot be definitely assigned to the iBoF DU.

Evaluating Bycatch in Commercial, Recreational, and Aboriginal Fisheries

Atlantic Salmon caught in the Bay of Fundy and, to an extent, the estuaries of iBoF may not be of iBoF origin. The DU of origin can only be determined through genetic analysis. Salmon incidentally caught in fisheries are not sampled and, as a result, their origin cannot be assigned

[illegible]

1. [illegible]
2. [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

As both the Provincial and National Recreational Creel Surveys could not reliably attest to salmon bycatch prevalence in the iBoF waters, the Provincial Enforcement Patrol Creel Survey records were canvassed (a.k.a. Blue Card Survey). The NSDFA did not report any records of Salmon bycatch in iBoF rivers. NBDNR provided records from 2007 to 2013.The NB enforcement officers interview anglers during patrols although these are: on a voluntary basis with a recent requested quota of 30 cards/officer/year, are geographically and temporally variable (i.e., each river is not consistently surveyed each year), and report details are variable among officers. Of the 425 Blue Cards submitted from the rivers of the NB iBoF region, only one incident of Atlantic Salmon bycatch in the NB iBoF region (Black River) was identified and indicates that five salmon parr where incidentally caught and subsequently released while fly fishing for Brook Trout.

Summary

Upon review of available information, it became evident that data on bycatch of Atlantic Salmon in the iBoF region is lacking. Assigning an accurate and quantifiable level of iBoF Atlantic Salmon bycatch mortality or harm in either commercial, recreational, or Aboriginal fisheries is not possible without the empirical data. To quantify the level of bycatch, mandatory recording and submission of bycatch information for this SARA listed species is recommended:

- to be included as a condition of license,
- to be included in the independent commercial landings data capture and entry (e.g., salmon is not an identified species in the SARA logbooks filled by Dockside Monitoring programs),
- that fishers are assured that they will not be prosecuted or penalized (e.g., license revocation) for reporting salmon bycatch,
- that participants in the Aboriginal FSC fisheries report salmon bycatch,
- that the National/Provincial recreational fisheries creel surveys include more precise fishing locations as well as salmon bycatch, and/or
- that fisheries are increasingly subjected to observer coverage in the fisheries that present a medium to high risk of intercepting salmon.

Impact of Bycatch in Licensed Fisheries on Survival and Recovery of iBoF Salmon

Presently, the lack of available and/or reliable salmon bycatch data in recreational, commercial, and Aboriginal fisheries presents great uncertainty in determining the actual level of impact of fisheries on the iBoF salmon population. For example, the efficiency and selectivity of gillnets are affected by restrictions on net length, depth, mesh size, hang ratio, and twine type (Wilson and Andrew 1987). The current gillnet license conditions only stipulate mesh size range restrictions and setting nets in a straight line. The actual descriptions of aforementioned gillnet criteria for each fishery was not available. This does not allow for a true evaluation of the efficiency at capturing, wedging, or entangling salmon in the gillnet fisheries.

Accuracy of Conclusions Drawn in the Recovery Potential Assessment for iBoF Salmon

A review in 2004 of all licensed fisheries (approximately 100) in the Bay of Fundy that could be impacting iBoF salmon populations through incidental catch identified 4 marine fisheries (gaspereau, shad, herring and mackerel gill net fisheries) that had both a high potential to capture salmon and a low potential for mitigation. In 2008, a Recovery Potential Assessment for iBoF Atlantic Salmon (DFO 2008) identified another 6 marine fisheries (eel fyke net and weir, smolt gill net, gaspereau trap net) deemed to have a moderate to high potential for incidental effects, but suggested a variety of measures that could be implemented to minimize the risk of incidental catch and mortality of salmon.

Potential Extent of Medium to High Risk Licensed Fisheries

The 2004 and 2008 conclusions were re-evaluated using the information found in Table 2 and applying the methodology developed in the most recent RPA for oBoF Salmon (Clarke et al. 2014). As bycatch information is not readily available, the potential 'intensity' of fisheries with highest likelihood or risk of intercepting and/or harming iBoF Atlantic Salmon was evaluated to determine the Extent of the fisheries used in the Level of Concern qualitative analysis described below. Again, this review was focused solely on fisheries within the iBoF Important Habitat Areas of highest priority (Area 1, 2, and 8 or corresponding FSD, RFA, or county as well as Area 3) to better report on the potential of iBoF salmon being intercepted. Updated potential gear amount is presented in Table 2 focusing on those activities previously assigned a moderate or high level of potential risk (Loch et al. 2004; Amiro 2004) applied to all three levels of licensed fisheries (i.e., commercial, recreational, and Aboriginal) by target species and gear type.

Although, the Herring purse seine fishery has been mentioned as a potential source of salmon bycatch, specifically post-smolts (Lacroix and Knox 2005), it was not considered a high risk fishery by Loch et al. (2004) since the fishery is uncommon in Minas Basin and Chignecto Bay. The Herring purse seine fishery effort was, therefore, omitted from this fishing effort review based on the low or 'unquantifiable' (i.e., fishing area outlined in licenses encompasses Bay of Fundy to whole Atlantic coast of NS) effort in the Minas Basin and Chignecto Bay as well as the origin of the salmon caught in other areas of the Bay of Fundy cannot be assumed to be from the iBoF DU.

Information provided in Table 2 coincides with the latest information available and is concentrated in the Chignecto Bay, Minas Basin, and Bay of Fundy. Since the current number of active licenses was not available (only available through reporting landings, which is privacy protected information), the number of licenses presented represents the potential number of licenses renewed or available for renewal in 2015. The majority of the specific geographic locations associated with each gear type are either not captured, not available, or cannot be presented as it would be in violation of the Privacy Act. As such, direct fishing pressure cannot be specifically determined for each important iBoF river and its estuary.

Potential Risk of Bycatch in Licensed Fisheries

Since a review of all available Provincial and Federal fisheries bycatch data indicated that there were either no recorded reports, minimal occurrences, or unreliable estimates of Atlantic Salmon bycatch, a quantitative risk assessment of the level of bycatch in licensed fisheries is not possible. A qualitative risk assessment was, therefore, conducted. The objective of this qualitative risk assessment was to assign a Level of Concern and highlight which fisheries pose the greatest potential for iBoF Salmon bycatch in the highest important iBoF salmon habitat areas in this review. The assessment included the updated fisheries information in Table 2, the updated highest important iBoF Salmon habitat (with a high likelihood of LGB salmon present), including Area 3 (Marshall 2014; DFO 2013; Lacroix 2013), and the medium-to-high risk fisheries recurrently identified (Amiro 2004; Loch et al. 2004). Four areas were considered: Important Area 2 Chignecto Bay (2CB), Area 2 Minas Basin (2MB), Area 3 (only Fisheries statistical district [FSD] 48) and Area 8 (FSD 40) (Appendix 1a and 1c; DFO 2013). The amount of fishing gear in Area 1 (tidal area of 19 rivers), one of the highest iBoF important habitat area, is encompassed within either the Area 2CB or 2MB values depending on the location of the rivers.

Important Area 2CB includes two of the LGB5 rivers, Upper Salmon and Point Wolf rivers. It also includes the Petitcodiac River where restoration efforts, following the causeway gate opening, have been extensive since 2010. Important Area 2MB includes two more LGB5 rivers, the Gaspereau and Stewiacke rivers and it also contains the majority of the remaining Top10 and Top19 rivers (Table 1; Appendix 3). The final LGB5 river, Big Salmon River, is within Important Area 3 (or FSD 48). Though it is not considered within the highest priority important habitat areas (DFO 2013), the fishing licenses within FSD 48 were assessed for proximity to the Big Salmon River estuary. Fisheries within FSD 48 were generally not site or area specific and included most of the Bay of Fundy coastal area of NB including FSDs 49, 52, and 53 (Appendix 1a, 1c, and Appendix 3). All licenses from each high risk fishery within the FSDs of interest were assigned to and tallied for each important habitat area to evaluate the potential extent of each fishery.

Gear type and restrictions are set to optimize the likelihood of capturing targeted species. Gear type and mesh of certain sizes may also trap salmon at various life stages. The likelihood of the salmon surviving is determined by the life stage captured and the gear-type of capture. For example, salmon caught in gillnets typically cannot be removed alive while salmon caught in either a weir or trapnet can be released alive. However, post-release mortality, resultant from injury from conditions within the weir trap, is of consideration. Gillnet fisheries are managed through mesh restrictions for the selected species although non-targeted species can get gilled, wedged, or tangled depending on: its body morphology (e.g., rough-bodied, spines), the gillnet hanging ratio (e.g., low hanging ratio tends to tangle rather than gill), and twine type (e.g., multifilament is less rigid so there is less chance to escape) (Wilson and Pierce 1984; Clay 1981; Potter and Pawson 1991, Wilson and Andrew 1987). Various studies assessed the efficiency of various gillnet mesh sizes at gilling, entangling, or wedging salmon. Gillnets with mesh sizes of 90 to 130mm are efficient at catching (i.e., gilling) adult salmon (Loch et al. 2004), although the smaller meshes could entangle or wedge a wide size range of salmon. Atlantic Salmon pelagic gillnet surveys in the U.S. found that the majority of Atlantic Salmon post-smolts were caught in 64 mm, 76 mm, and 89 mm mesh while adult salmon were caught in the 102 mm, 114 mm, and 127 mm (Sheehan et al. 2012; Dempson et al. 2001) noted that 1SW salmon, are highly selected in 114 mm mesh.

The gillnet fisheries assessed here have a wide variety of mesh sizes depending on the species of interest. However, mesh sizes are described in the fisheries restriction as a 'less than' or 'greater than' x millimeters, and the exact mesh size for each fishery is not known. Each commercial gillnet fishery evaluated, except the Smelt (smaller mesh size) and Mackerel (no information available) gillnet fishery, was assessed as either a high or extreme level of concern since they were found throughout the Important Area 2 (CB and MB) at potentially varying degrees of intensity. As adult salmon are of primary concern, the Shad and Groundfish gillnet fisheries, which utilize large mesh, would be very efficient at catching returning salmon or kelts and are potentially active throughout the Chignecto Bay and Minas Basin. In the Labrador gillnet fisheries, the gillnet mesh size was restricted to less than 114mm to reduce the bycatch of large salmon (DFO and MRNF 2009) but since iBoF Salmon generally mature as small salmon, gillnets greater than 90mm were considered likely to catch iBoF Salmon adults or kelts (Loch et al. 2004).

The qualitative risk assessment associated with each outlined fishery was evaluated by considering:

1. selectivity/efficiency of the gear (e.g., gear type, mesh size),
2. salmon life stage affected,
3. level of harm (e.g., likelihood of live release or mortality), and
4. availability of the gear (i.e., gear distribution, fishing season) (Table 2).

The overall ranking of the risk was adapted from the approach developed by Clarke et al. (2014) where the information available for selectivity/efficiency and level of harm was assigned a severity rating and availability was assigned a level of extent rating (Appendix 4). The overall level of concern was then assigned from the resulting level defined in the Extent and Severity matrix table described in Appendix 4.

Table 2. An updated summary of potential gear associated with the licensed fisheries assessed as moderate to high potential risk of incidentally affecting iBoF Atlantic Salmon in the Bay of Fundy (adapted from Loch et al. 2004) as well as a qualitative risk assessment to highlight the areas of concern where iBoF Atlantic Salmon could be incidentally caught throughout the DU. Severity, extent, and overall level of concern ratings are described in Appendix 4. The potential amount of gear is used as secondary information in the evaluation of the level of concern for each fishery. (lics = licenses, UNK = Unknown, FSC = Food, Social, and Ceremonial, fth = fathoms, N/A = not applicable).

Species	Gear	Salmon life stage impacted	Fisheries	Gear Restrictions[1]	Open Season[1]	Potential amount of gear in[2]				Evaluation of Potential impact			Comment
						2CB[3]	2MB[3]	Area 8[3]	FSD48[4]	Severity	Extent	Level of Concern	
Trout sp.	Angling	Adult , kelts, smolts, and parr. Llive release possible but injury feasible	**Recreational[5,8]**	Inland (NS)- includes: e.g., < 2 hooks/fly (see fishing guide book for complete list). Inland (NB): includes: e.g., < 2 hooks/fly (see fishing guide book for complete list). Tidal: angling only	(NS) Apr 1 - Sept 30 (NB) Apr 15 – Sept 15	(NB) 44,718 total days in rivers	(NS) 124,591 total days fished in rivers and lakes	(NS) 21,001 total days fished in rivers and lakes	Same as 2CB	M	VH	Medium	Concern possibly lower in freshwater as restrictions do not apply in tidal waters.
			Commercial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Aboriginal (FSC[6]/ Commercial)	Unknown	All year	FSC- 4 First Nation Communities Commercial: N/A				M	UNK	Unknown	
Striped Bass[6]	Angling	Adult, kelts, smolts, and parr. Live release possible but injury feasible	**Recreational[5,7,8]**	Inland (NS)- includes: e.g., < 2 hooks/fly (see fishing guide book for complete list). Inland (NB): includes: e.g., < 2 hooks/fly (see fishing guide book for complete list). Tidal: angling or bownet only	Inland NS: Apr 15- Sept 30 Inland NB: May 1- Sept 15 Tidal: All year	(NB) 1,003 total days in rivers	(NS) 38,232 total days fished in rivers and lakes	(NS) 11,158 total days fished in rivers and lakes	Same as 2CB	M	VH	Medium	Concern more applicable to tidal waters as restrictions do not apply
			Commercial	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Aboriginal (FSC[6]/ Commercial)	Unknown	All year	FSC- 3 First Nation Communities Commercial: N/A				M	UNK	Unknown	
Shad	Gillnet (set/drift)	Adults and kelts but live release NOT probable.	**Recreational**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial[9]	Mesh size: >127mm	Set: Variable by county/region e.g., Shepody Bay: May 1- Aug 15 Drift: Variable by county/region e.g., in tidal water Shubenacadie/Stewiacke: Apr 1- June 15	Set: 8 nets, 2,260 fth Drift:13 nets, 4,400 fth	Set:25 nets, 3,160 fth Drift:16 nets, 2,105 fth	Set/Drift: N/A	Set: 1 net, 180 fth Drift: N/A	E	VH	High	Seasons varied to reduce the possibility of intercepting salmon
			Aboriginal (FSC[6]/ Commercial)	Unknown	2 FSC: all year, 2 FSC: May-Jun/Jun-Jul with weekend closures	FSC- 4 First Nation Communities Commercial: N/A				E	UNK	Unknown	
Gaspereau	Gillnet (set/drift)	Post-smolts, and smolts but live	**Recreational**	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial[8]	Mesh size: < 89mm	Set: Variable by county/region usually Mar 15- May 31 or Mar 15- Jul 10	Set: 7 nets, 870 fth	Set: 26 nets, 2,710 fth	Set/Drift: N/A	N/A	H	VH	High	

Species	Gear	Salmon life stage impacted	Fisheries	Gear Restrictions[1]	Open Season[1]	Potential amount of gear in[7]				Evaluation of Potential impact			Comment
						2CB[3]	2ME[3]	Area 8[3]	FSD46[4]	Severity	Extent	Level of Concern	
		release NOT probable.			Drift: Variable by county/region usually Mar 15-May 31 or Mar 15- Jul 10	Drift: N/A	Drift: 23 nets, 1,805 fth						
			Aboriginal (FSC[5]/ Commercial)	Unknown	All year or May/June	FSC- 3 First Nation Communities Commercial: 1 lic (2 weirs)				H	UNK	Unknown	
	Trap net	Adults, kelts, post-smolts, and smolts but live release probable.	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial[6]	Unknown	Variable by county/region usually Mar 15- May 31 or Mar 15- Jul 10	4 traps	N/A	N/A	N/A	M	VH	Medium	
			Aboriginal (FSC[5]/ Commercial)	N/A	N/A	N/A				N/A	N/A	N/A	
	Square net	Adults, kelts, and smolts but live release probable.	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial[6]	<3.65m[2] and extends < 1/3 width of river and outside wall <9m	Mar 15- May 31	N/A	15 nets	N/A	N/A	M	VH	Medium	Found in Gaspereau R. (LGBB) only
			Aboriginal (FSC[5]/ Commercial)	N/A	N/A	N/A				N/A	N/A	N/A	
Herring	Gillnet (set/drift)	Post-smolts but live release NOT probable.	Recreational	Mesh size: < 83mm Other: No use of monofilament between May 1- Jul 15	All year	Set: 6 lics, 180 fth	Set: 63 lics, 1,890 fth	Set: 4 lics, 120 fth	N/A	H	UNK	Unknown	
			Commercial[6]	Mesh size: < 83mm Other: No use of monofilament between May 1- Jul 15	All year *typically fished: July-October/November	Set: 72 nets, 10,280 fth Drift: 12 nets, 4,140 fth	Set: 488 nets, 46,381 fth Drift: 6 nets; 540 fth	Set: 78 nets, 19,080 fth Drift: N/A	Set: 12 nets, 900 fth Drift: 6 nets, 540 fth	H	VH	High	Restrictions on the use of monofilament improves net avoidance by migrating salmon
			Aboriginal (FSC[5]/ Commercial)	Unknown	All year	FSC- 3 First Nation Communities Commercial: Set: 7 lics, 3,020 fth Drift: 1 lics, 90 fth				H	UNK	Unknown	
	Weir/Trap net	Adults, kelts, and post-smolts but live release probable.	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial[6]	Unknown	Open all year *typically fished: June-October	N/A	8 lics	1 lics	N/A	M	VH	Medium	
			Aboriginal (FSC[5]/ Commercial)	Unknown	All year	FSC- 1 First Nation Community Commercial: N/A				M	UNK	Unknown	
Mackerel	Gillnet (set/drift)	Post-smolts but live release NOT probable	Recreational	Mesh size:< 83mm No use of monofilament between May 1- July 15	All year	N/A	1 lic, 30 fth	N/A	N/A	H	UNK	Unknown	
			Commercial[6]	Mesh size:< 83mm No use of monofilament between May 1-	All year	Gillnet licenses are designated in the license condition and are valid for all Maritimes region waters.				H	UNK	Unknown	Mandatory restriction on use of monofilament

Species	Gear	Salmon life stage impacted	Fisheries	Size Restrictions	Open Season	Potential amount of gear in [illegible]				Evaluation of Potential Impact			Comment
						[illegible]	[illegible]	[illegible]	[illegible]	Severity	Extent	Level of Concern	
				[illegible]									[illegible]
			Aboriginal (FSC) Commercial	Unknown	All year	FSC: [illegible] First Nation Communities Commercial: [illegible]				[illegible]	[illegible]	Unknown	
	Weir/Trap net	Adults, kelts, and post-smolts, live release probable	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial	Unknown	Unknown	N/A	N/A	[illegible]	N/A	[illegible]	[illegible]	Medium	
			Aboriginal (FSC) Commercial	N/A	N/A	N/A				N/A	N/A	N/A	
Smelt	Gillnet [illegible]	Post-smolt, live release NOT probable	Recreational	Mesh size [illegible]	[illegible]	[illegible]	[illegible]	N/A	N/A	[illegible]	[illegible]	Low	
			Commercial	Mesh size [illegible]	[illegible]	[illegible]	[illegible]	[illegible]	N/A	[illegible]	[illegible]	Low	
			Aboriginal (FSC) Commercial	Unknown	All year	FSC: [illegible] First Nation Communities Commercial: N/A			N/A	[illegible]	[illegible]	Unknown	
Groundfish [illegible]	Gillnet	Adults and kelts, live release NOT probable	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	[illegible]
			Commercial	Mesh size [illegible] The floats of the net [illegible] below the surface	All year Typically occurs between April–September	[illegible]	[illegible]	N/A	N/A	[illegible]	[illegible]	High	
			Aboriginal (FSC) Commercial	Unknown	All year	FSC: [illegible] First Nation Communities [illegible] Commercial: [illegible]				[illegible]	[illegible]	Unknown	
	Weir/Trap net	Adults, kelts, and post-smolts, live release probable	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial	Unknown	Open all year Typically occurs between April–September	N/A	[illegible]	N/A	N/A	[illegible]	[illegible]	Medium	
			Aboriginal (FSC) Commercial	N/A	N/A	N/A				N/A	N/A	N/A	
Eel	Trap net	Adults, kelts, smolts, and post-smolts, live release probable	Recreational	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	N/A	
			Commercial	Unknown	[illegible]	N/A	[illegible]	[illegible]	N/A	[illegible]	[illegible]	Medium	[illegible]
			Aboriginal	Unknown	All year	FSC: [illegible] First Nation Communities				[illegible]	[illegible]	Unknown	

[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]				[illegible]			[illegible]
						[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
			[illegible]			[illegible]							
	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
			[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	
			[illegible]	[illegible]	[illegible]	[illegible]				[illegible]	[illegible]	[illegible]	

[illegible]

[illegible]

[illegible]

[illegible]

Conclusions

[illegible]

- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]
- [illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]

[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]
[illegible]	[illegible]

[illegible]

[illegible]
[illegible]
[illegible]
[illegible]
[illegible]

[illegible]

[illegible]

Amiro, P.G., J.C. Brazner, and J.L. Giorno. 2008. Assessment of the Recovery Potential for the Atlantic Salmon Designatable Unit Inner Bay of Fundy: Threats. DFO Can. Stock Assess. Sec. Res. Doc. 2008/059.

Bristow Consulting Inc. 2012. 2010 Survey of Recreational Fishing in New Brunswick with Summary Information from the 1985 Through 2005 Surveys. NB Dept. Nat. Resourc. (internal document). 280 p.

Clarke, C.N., S.M. Ratelle, and R.A. Jones. 2014. Assessment of the Recovery Potential for the Outer Bay of Fundy Population of Atlantic Salmon: Threats to Populations. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/006.

Clay, D. 1981. A New Technique for Estimation of Gillnet Selectivity and Re-analysis of Data for Several Fish Species. NAFO Sci. Coun. Studies, No. 1: 7-22.

COSEWIC. 2010. COSEWIC Assessment and Status Report on the Atlantic Salmon *Salmo salar* (Nunavik Population, Labrador Population, Northeast Newfoundland Population, South Newfoundland Population, Southwest Newfoundland Population, Northwest Newfoundland Population, Quebec Eastern North Shore Population, Quebec Western North Shore Population, Anticosti Island Population, Inner St. Lawrence Population, Lake Ontario Population, Gaspé-Southern Gulf of St. Lawrence Population, Eastern Cape Breton Population, Nova Scotia Southern Upland Population, Inner Bay of Fundy Population, Outer Bay of Fundy Population) in Canada. Committee on the Status of Endangered Wildlife in Canada. Ottawa. xlvii + 136 pp.

Dempson, J.B., C.J. Schwarz, D.G. Reddin, M.F. O'Connell, C.C. Mullins, and C.E. Bourgeois. 2001. Estimation of Marine Exploitation Rates on Atlantic Salmon (*Salmo salar* L.) Stocks in Newfoundland, Canada. ICES J. Mar. Sci., 58: 331–341.

DFO. 2008. Recovery Potential Assessment for Inner Bay of Fundy Atlantic Salmon. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2008/050.

DFO. 2010. Recovery Strategy for the Atlantic Salmon (*Salmo salar*), Inner Bay of Fundy Populations [Final]. In Species at Risk Act Recovery Strategy Series. Ottawa: Fisheries and Oceans Canada.

DFO. 2013. Important Marine and Estuarine Habitat of Inner Bay of Fundy Atlantic Salmon. DFO Can. Sci. Advis. Sec. Sci. Advis. Rep. 2013/054.

DFO and MRNF. 2009. Conservation Status Report, Atlantic Salmon in Atlantic Canada and Québec: PART II - Anthropogenic Considerations. Can. MS Rep. Fish. Aquat. Sci. No. 2870, 175 p.

Gavaris, S., K.J. Clark, A.R. Hanke, C.F. Purchase, and J. Gale. 2010. Overview of Discards from Canadian Commercial Fisheries in NAFO Divisions 4V, 4W, 4X, 5Y and 5Z for 2002-2006. Can. Tech. Rep. Fish. Aquat. Sci. 2873.

Gibson, A.J.F., H.D. Bowlby, J.R. Bryan, and P.G. Amiro. 2008. Population Viability Analysis of Inner Bay of Fundy Atlantic Salmon with and Without Live Gene Banking. DFO Can. Stock Assess. Sec. Res. Doc. 2008/057.

Lacroix, G.L. 2013. Population-specific Ranges of Oceanic Migration for Adult Atlantic Salmon (*Salmo salar*) Documented Using Pop-up Satellite Archival Tags. Can. J. Fish. Aquat. Sci. 70: 1011–1030.

Lacroix, G.L., and D. Knox. 2005. Distribution of Atlantic Salmon (*Salmo salar*) Postsmolts of Different Origins in the Bay of Fundy and Gulf of Maine and Evaluation of Factors Affecting Migration, Growth, and Survival. Can. J. Fish. Aquat. Sci. 62: 1363-1376.

Loch, J.S., J.R. Ritter, and D. Rowland. 2004. Assessment of the Incidental Effects of Federally Licensed Fisheries on Inner Bay of Fundy Atlantic Salmon Populations. Contract Report (Purchase Order No. F5627-30016) for the DFO Maritime Region's Species at Risk Coordination Office. 85 p.

Marshall, T.L. 2014. Inner Bay of Fundy (iBoF) Atlantic Salmon (*Salmo salar*) Marine Habitat: Proposal for Important Habitat. DFO Can. Sci. Advis. Sec. Res. Doc. 2013/071.

NSDFA. 2012. A Survey of the Sportfishing Industry in Nova Scotia. NS Dept. Fish and Aqua- Inl. Fish. Div. 20 p.

O'Reilly, P.T., and C.J. Harvie. 2010. Conservation of Genetic Variation in the Inner Bay of Fundy Atlantic Salmon Captive Breeding and Rearing Program. DFO Can. Sci. Advis. Sec. Res. Doc. 2009/095. viii + 53 p.

Potter, E.C.E., and M.G. Pawson. 1991. Gill Netting. Lab. Leafl. MAFF Direct. Fish. Res., Lowesoft, (69).

Sheehan, T.F., D.G. Reddin, G. Chaput, and M.D. Renkawitz. 2012. SALSEA North America: A Pelagic Ecosystem Survey Targeting Atlantic Salmon in the Northwest Atlantic. ICES J. Mar. Sci. doi:10.1093/icesjms/fss052.

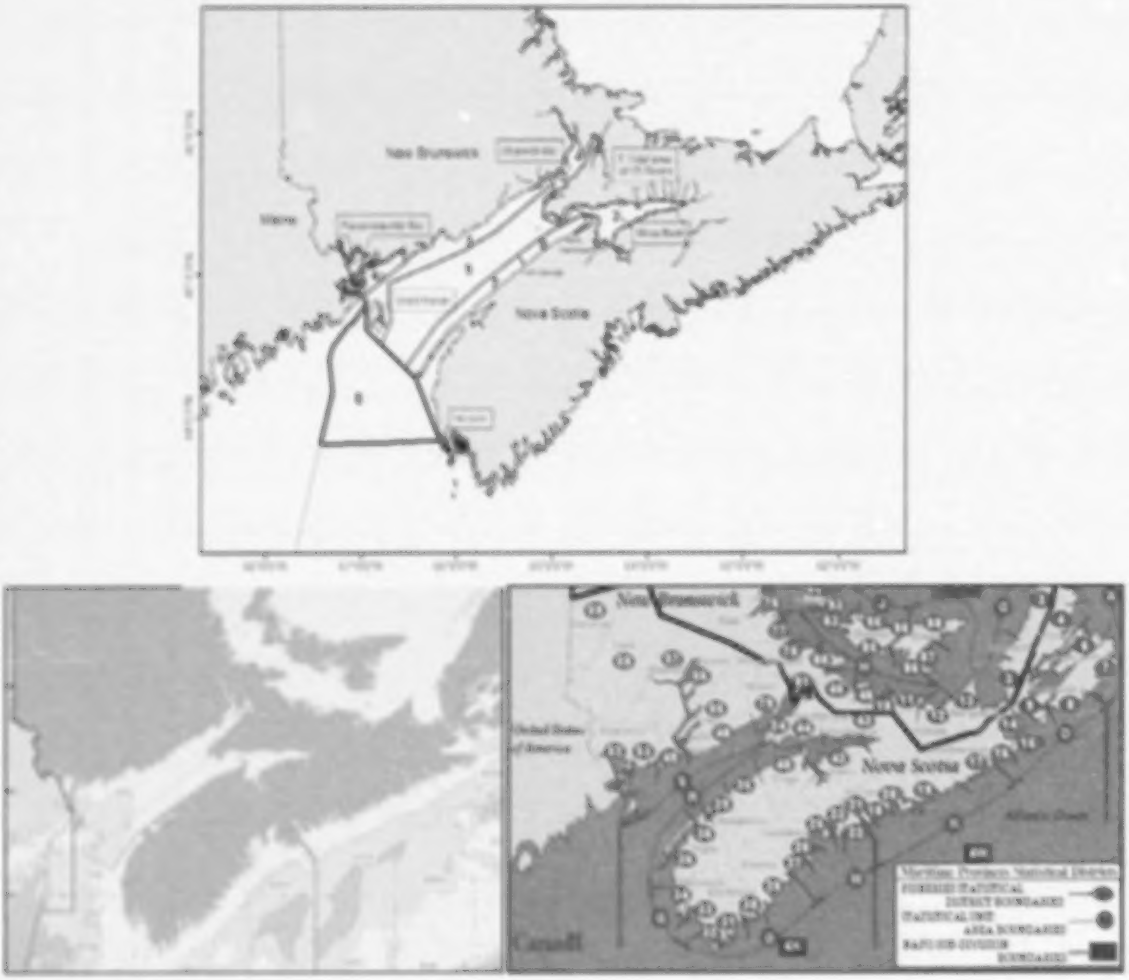
Wilson, K.H., and J.H. Andrew. 1987. Influence of Gill Net Hang Ratio on the Catch of Salmon in the Fraser River. Can. Tech. Rep. Fish. Aquat. Sci. 1516.

Wilson, K.H., and B.C. Pearce. 1984. The Relative Selection of Three Mesh Sizes of Fraser River Sockeye Gillnets for Chinook Salmon. Can Tech. Rep. Fish. Aquat. Sci. 1250.

Appendices

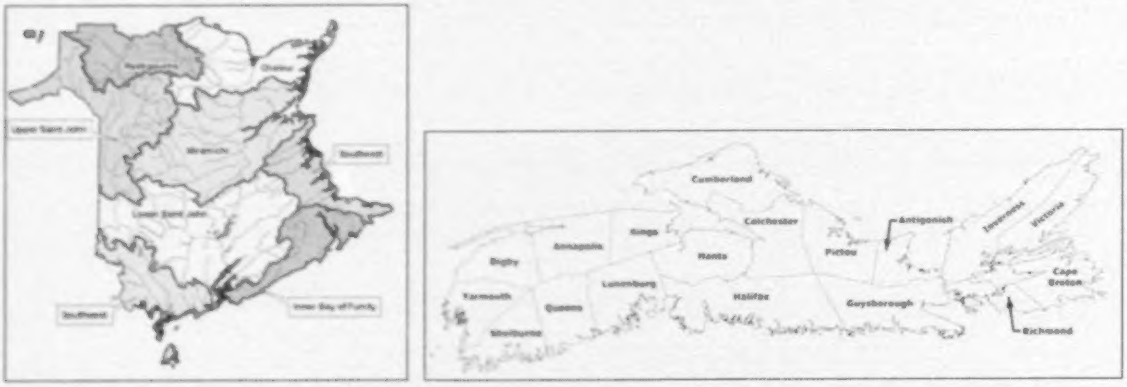
Appendix 1.

(a) As per DFO (2013), areas identified within the important habitat bounding box for iBoF Atlantic Salmon: Area 1 - tidal portions of 19 iBoF Salmon rivers, Area 2 - Minas Basin and Chignecto Bay, Area 3 - Bay of Fundy New Brunswick coastal outflow, Area 4 - Passamaquoddy Bay/Fundy Isles, Area 5 - middle of the BoF, Area 6 - northern Gulf of Maine, Area 7 - coastal southwest Nova Scotia: Yarmouth to Port George, and Area 8 - coastal southwest Nova Scotia: Port George to Hall's Harbour; (b) The NAFO Divisions and unit areas used in Fisheries Management; and (c) DFO Maritime Statistical Districts although district 41 is not visible, it is defined as 'the portion of Kings east of Cape Split to the Hants County line (southern portion of Minas Basin).


New Brunswick
Maine
Nova Scotia
New Brunswick
United States of America
Nova Scotia
Atlantic Ocean
Canada
Maritime Provinces Statistical Districts
FISHERIES STATISTICAL DISTRICT BOUNDARIES
STATISTICAL UNIT AREA BOUNDARIES
NAFO SUB-DIVISION BOUNDARIES

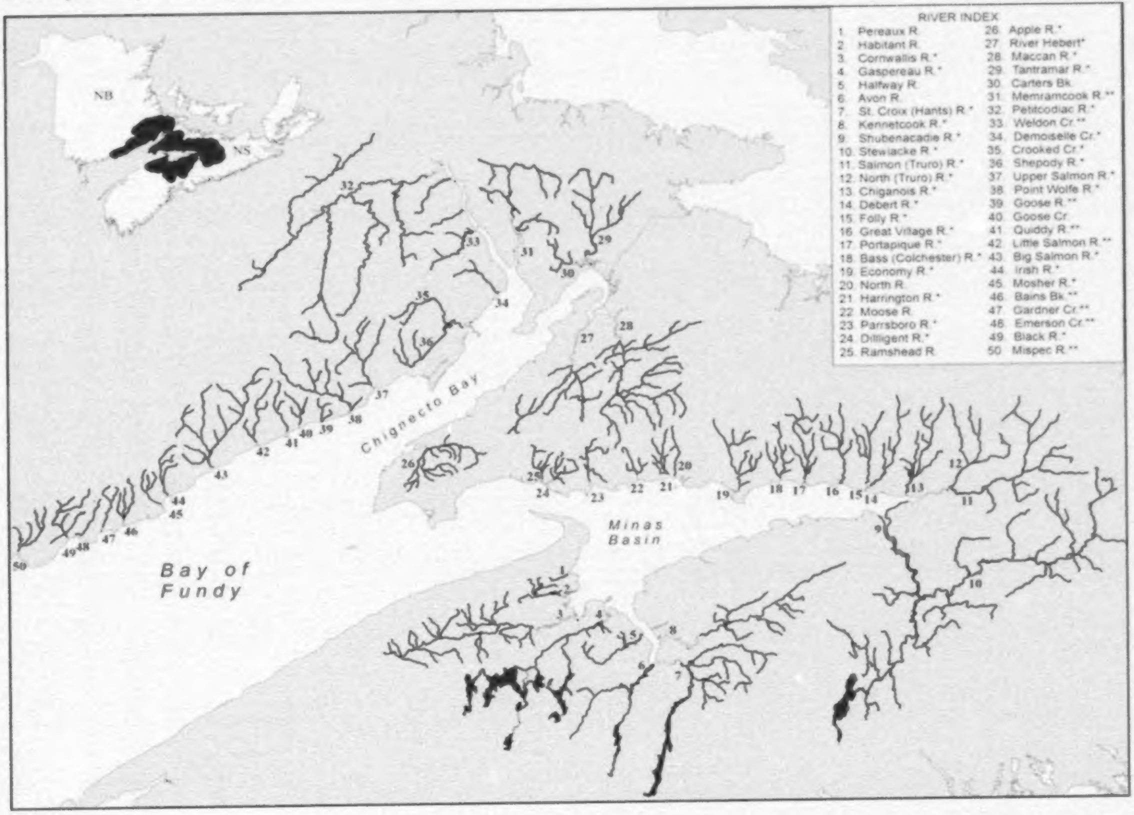
Appendix 2.

Maps associated with the National Creel Survey provided to anglers in either NB or NS for reference on angling location, a) New Brunswick Recreational Fishing Area, iBoF outlined in bottom-right corner, and b) fishing areas in Nova Scotia delineated by counties, iBoF rivers found in Cumberland, Colchester, Hants, and Kings counties.


a)
Restigouche
Chaleur
Upper Saint John
Miramichi
Southeast
Lower Saint John
Southwest
Inner Bay of Fundy
Cumberland
Colchester
Antigonish
Inverness
Victoria
Kings
Annapolis
Digby
Hants
Pictou
Lunenburg
Yarmouth
Queens
Halifax
Guysborough
Cape Breton
Shelburne
Richmond

Appendix 3.

Inner Bay of Fundy rivers. The rivers marked with an (*) supported self-sustaining Atlantic Salmon populations as suggested by recreational catch and historical electrofishing data. The (**) identified rivers are reported to have produced salmon.


NB
NS
Chignecto Bay
Minas Basin
Bay of Fundy
RIVER INDEX
1. Pereaux R.
2. Habitant R.
3. Cornwallis R.*
4. Gaspereau R.*
5. Halfway R.
6. Avon R.
7. St. Croix (Hants) R.*
8. Kennetcook R.*
9. Shubenacadie R.*
10. Stewiacke R.*
11. Salmon (Truro) R.*
12. North (Truro) R.*
13. Chiganois R.*
14. Debert R.*
15. Folly R.*
16. Great Village R.*
17. Portapique R.*
18. Bass (Colchester) R.*
19. Economy R.*
20. North R.
21. Harrington R.*
22. Moose R.
23. Parrsboro R.*
24. Dilligent R.*
25. Ramshead R.
26. Apple R.*
27. River Hebert*
28. Maccan R.*
29. Tantramar R.*
30. Carters Bk.
31. Memramcook R.**
32. Petitcodiac R.*
33. Weldon Cr.**
34. Demoiselle Cr.*
35. Crooked Cr.*
36. Shepody R.*
37. Upper Salmon R.*
38. Point Wolfe R.*
39. Goose R.**
40. Goose Cr.
41. Quiddy R.**
42. Little Salmon R.**
43. Big Salmon R.*
44. Irish R.*
45. Mosher R.*
46. Bains Bk.**
47. Gardner Cr.**
48. Emerson Cr.**
49. Black R.*
50. Mispec R.**

Appendix 4.

Methodology for assessing Level of Concern: The level of risk signifies the concern that iBoF Atlantic Salmon would be incidentally caught or harmed by the fishery. Using the information available for each fishery found in Table 2, the level of severity and level of extent is assessed using the following tables and matrix. Once both levels have been assigned, the results are entered into the matrix (Table A3.3) to define an overall Level of Concern.

Table A4.1 - Description of how severity was assigned to each fishery.

Category	Description
Negligible (N)	• The gear is unlikely to trap a salmon; live release is probable • None or only smolt life stage are likely affected
Low (L)	• The gear is likely to trap a salmon; live release is probable • Only smolt and/or post-smolt life stages are likely affected
Medium (M)	• The gear is likely to trap a salmon; live release is probable • Adult and kelt life stages are likely affected
High (H)	• The gear is likely to trap a salmon; live salmon release NOT probable • Smolt and/or post-smolt are likely affected
Extreme (E)	• The gear is likely to trap a salmon[1]; live salmon release NOT probable • Adult and kelt life stages are likely affected

[1] Loch et al. 2004 indicated that gillnets greater than 90mm were most likely to catch iBoF salmon

Table A4.2 - Description of the spatial extent of the threat.

Category	Description
Low (L)	• In 'Unsupported'[1] rivers or Important Marine Area not defined as highest priority. • Fisheries season does not overlap with salmon presence at location.
Medium (M)	• Gear potentially present in the vicinity of one or more of the remaining Top19 rivers (excludes the Top10 included in Top19) or licenses not defined by exact river but in Statistical District/Area 2 (CB and MB) 'housing' Top19 rivers. • Fisheries season overlaps with salmon presence at location.
High (H)	• Gear present in one or more of the remaining Top10 rivers (excludes the LGB5 included in TOP10) or licenses not defined by exact river but in FSD/ Area 2 (CB and MB) 'housing' Top10 rivers. • Fisheries season overlaps with salmon presence at location.
Very high (VH)	• Gear present in one or more of the LGB5 rivers or licenses not defined by exact river but in Statistical District/ Area 2 (CB and MB) 'housing' LGB5

Category	Description
	rivers PLUS the Petitcodiac River. • Fisheries season overlaps with salmon presence at location

[1] Defined as the iBoF not receiving support from the Live Gene Bank

Table A4.3 - Level of risk rank assignment matrix as defined by Clarke et al. 2014.

		Severity				
		Negligible	**Low**	**Medium**	**High**	**Extreme**
Extent	**Low**	Low	Low	Low	Low	Medium
	Medium	Low	Low	Medium	Medium	Medium
	High	Low	Low	Medium	High	High
	Very High	Low	Medium	Medium	High	High

Reference

Clarke, C.N., S.M. Ratelle, and R.A. Jones. 2014. Assessment of the Recovery Potential for the Outer Bay of Fundy Population of Atlantic Salmon: Threats to Populations. DFO Can. Sci. Advis. Sec. Res. Doc. 2014/006. v + 103 p.

This Report is Available from the

Centre for Science Advice (CSA)
Maritimes Region
Fisheries and Oceans Canada
Bedford Institute of Oceanography
1 Challenger Drive, PO Box 1006
Dartmouth, Nova Scotia B2Y 4A2

Telephone: 902-426-7070
E-Mail: XMARMRAP@dfo-mpo.gc.ca
Internet address: www.dfo-mpo.gc.ca/csas-sccs/

ISSN 1919-3769
© Her Majesty the Queen in Right of Canada, 2016

Correct Citation for this Publication:

DFO. 2016. Updated Information on Fishing Bycatch of Atlantic Salmon, Inner Bay of Fundy Population, and its Impact on the Survival or Recovery of this Atlantic Salmon Designatable Unit (DU). DFO Can. Sci. Advis. Sec. Sci. Resp. 2016/023.

Aussi disponible en français :

MPO. 2016. Mise à jour des renseignements sur les prises accessoires de la population de saumon de l'Atlantique de l'intérieur de la baie de Fundy et de leurs répercussions sur la survie ou le rétablissement de cette unité désignable du saumon de l'Atlantique. Secr. can. de consult. sci. du MPO, Rép. des Sci. 2016/023.